ABSTRACT

An improved FM In-Band-On-Channel (IBOC) system using Orthogonal Frequency Division Multiplexing (OFDM) has timing and data recovery for correction of timing and frequency offset between transmitters and receivers. Offset causes OFDM frame synchronization and data demodulation errors. In the system, an OFDM receiver recovers an rf signal as in-phase (I) and quadrature phase (Q) components of a baseband signal. sampled at a selected number of points, e.g. 544 in an analog/digital converter. The output of the converter is stored in a two-deep FIFO. The I and Q components of a received symbol are correlated at all 544 sampling points. The correlation values are averaged over the latest L frames and saved in an L-deep FIFO. The amplitude and phase of the symbols are computed and passed to an offset estimator and an OFDM frame synchronization estimator. The amplitude is used to estimate the frame boundary in the frame synchronization estimator which provides a frame pointer to a phase-locked loop oscillator designed to achieve fast OFDM frame synchronization. The phase-locked loop oscillator provides a sample number indicating the OFDM frame boundary to the offset estimator. An estimated offset value is selected as the negative of the phase angle of the auto correlation function at the above sample number. The offset value is applied to the frame stored in the two-deep FIFO and identified by the sample number for correcting the time domain samples of the useful symbol period, after which the corrected samples are applied to the input of an FFT block and thence to a data demodulator. A programmable counter coupled to the phase locked loop locks the receiver clock to the transmitter clock.